

# Vehicle Routing Optimization

SAS Optimization

Ben Murphy  
Michigan SAS Users Group 2025



# Background

## What is Operations Research?

Finding the **optimal** solution to **challenging decision** problems with complicated **constraints** or parameters

- Optimal: minimize cost, maximize revenue, minimize time, etc.
- Challenging Decisions: many related decisions, each more complex than the previous
- Constraints & Parameters: finite time, finite human resources, limited technology or computing power

# If you deal with...



Limited resources



A widening array of  
available actions



Diverse customers' needs  
and expectations



Government regulations



Changing business  
requirements or competition

...then you should care about optimization!

# SAS Optimization

## Key Capabilities



### Time to Value

- SAS embeds all the analytical steps from descriptive to prescriptive, significantly reducing time to value.



### Powerful Solvers

- Access to LP, MILP, QP, conic, NLP, CLP, network, and black-box solvers.



### Flexibility

- Support for creation and use of custom algorithms. Can even embed machine learning models in the optimization model syntax



### Computational Speed

- Faster decisions at scale with SAS multithreaded and distributed computation.



### Open-Source Integration

- Easily accessible to open-source users with sasoptpy package.



### Customer Support

- All the support you need with access to training courses, practical examples, and SAS Center of Excellence team of PhD level optimization experts.

# Applications Across Industries

Some of the many ways we've helped our customers...

Banking	Government	Health & Life Science	Manufacturing & Energy	Comms & Retail
				
ATM Replenishment	Water Management	Chemical Mixture Optimization	Supply Chain Optimization	TV Advertising Optimization
Investment Portfolio Optimization	Price Optimization for Railroad	Medical Resource Optimization	Inventory Planning	Price and Inventory Optimization
Optimal Loan Assignment	Vehicle Routing	Hospital Room Assignment Simulation	Avoiding Downtime in Production Line	SKU Profitability

# Vehicle Routing Optimization

## Use Case Overview

- Healthcare organizations serving patients away from brick-and-mortar providers
- Vehicles with medical equipment, sometimes specialized, i.e. audiology, ophthalmology, radiology



Where are we going to deploy the vehicles to best serve patients?

# Vehicle Routing Optimization

## Process Modernization & Optimization

- Current processes are often:
  - manual
  - partially data driven
  - not standardized
  - complicated but not comprehensive
  - include some incomplete or partial data analysis and visualization
  - disconnected from related business operations, such as vehicle maintenance
- Process Modernization & Optimization includes:
  - automate data processing tasks
  - identify, score, prioritize site candidates
  - select groups of sites as routes by KPI
  - compare route options and refine routing criteria based on subject matter expertise
  - prepare optimal turn by turn routing

# Vehicle Routing Optimization

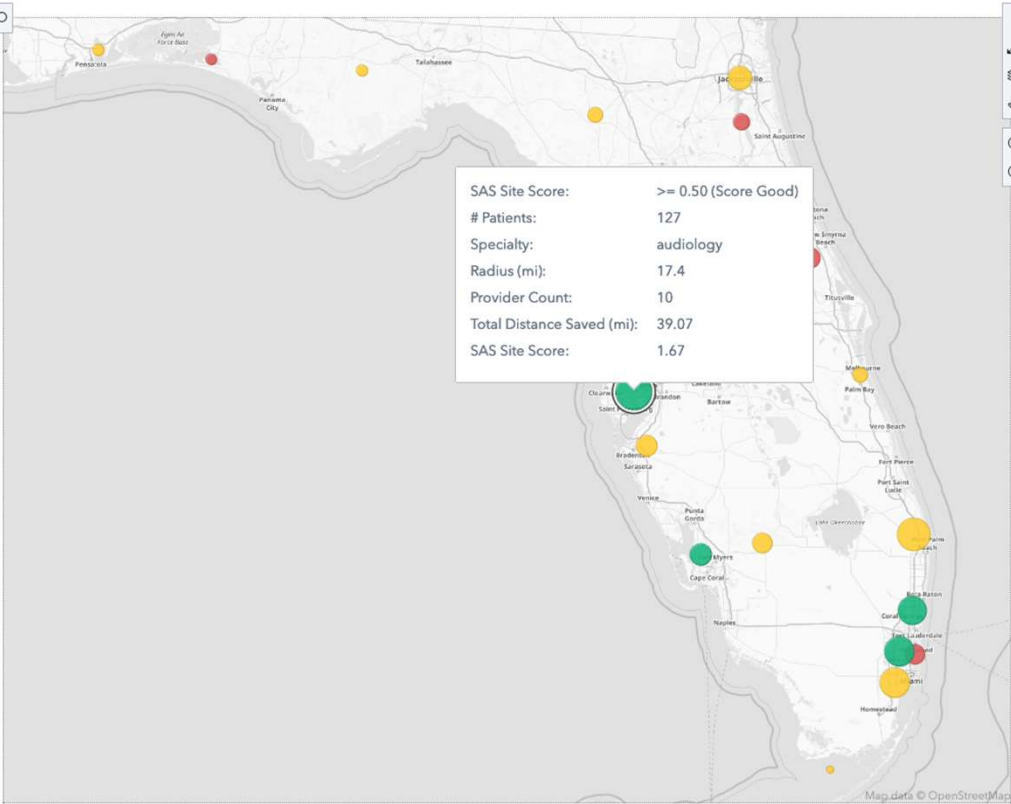
## Key Steps and Solution Techniques

Key Process Steps	Solution Techniques
Patient Classification – specialty, location	Network Community Detection
Comparison of Patients to Providers – availability, proximity	Geolocation
Vehicle Equipment Availability – location, suitable specialty equipment, maintenance	Proactive / Predictive Vehicle Maintenance Internet of Things (IoT)
Site Selection – quantity and density of patients – travel saved for patients relative to closest provider	Business based heuristics codified as optimization problems
Vehicle Routing Site to Site – order of stops, driving directions	Vehicle Routing Problem Turn By Turn Directions



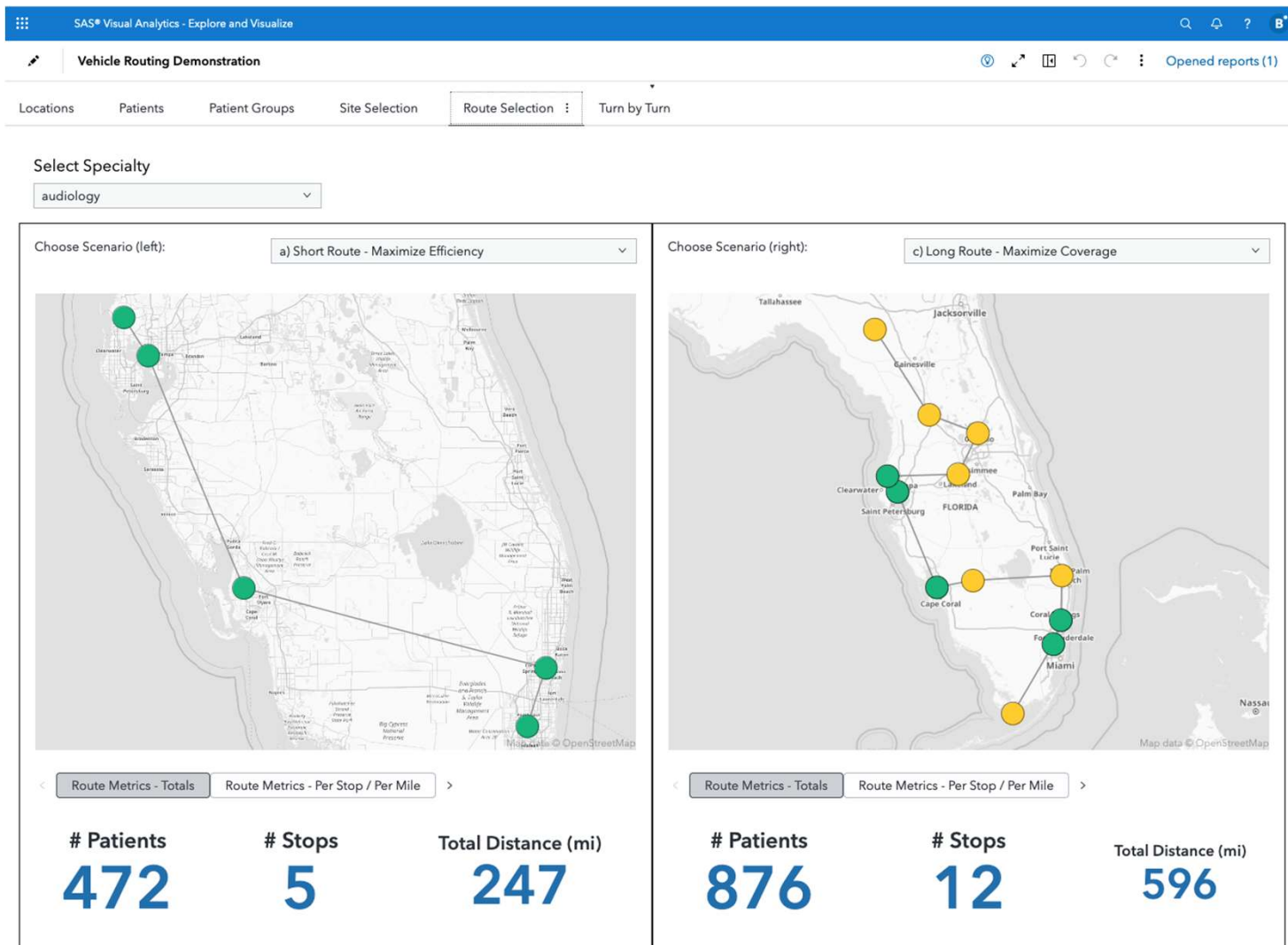
Choose Specialty:

audiology



Site Details

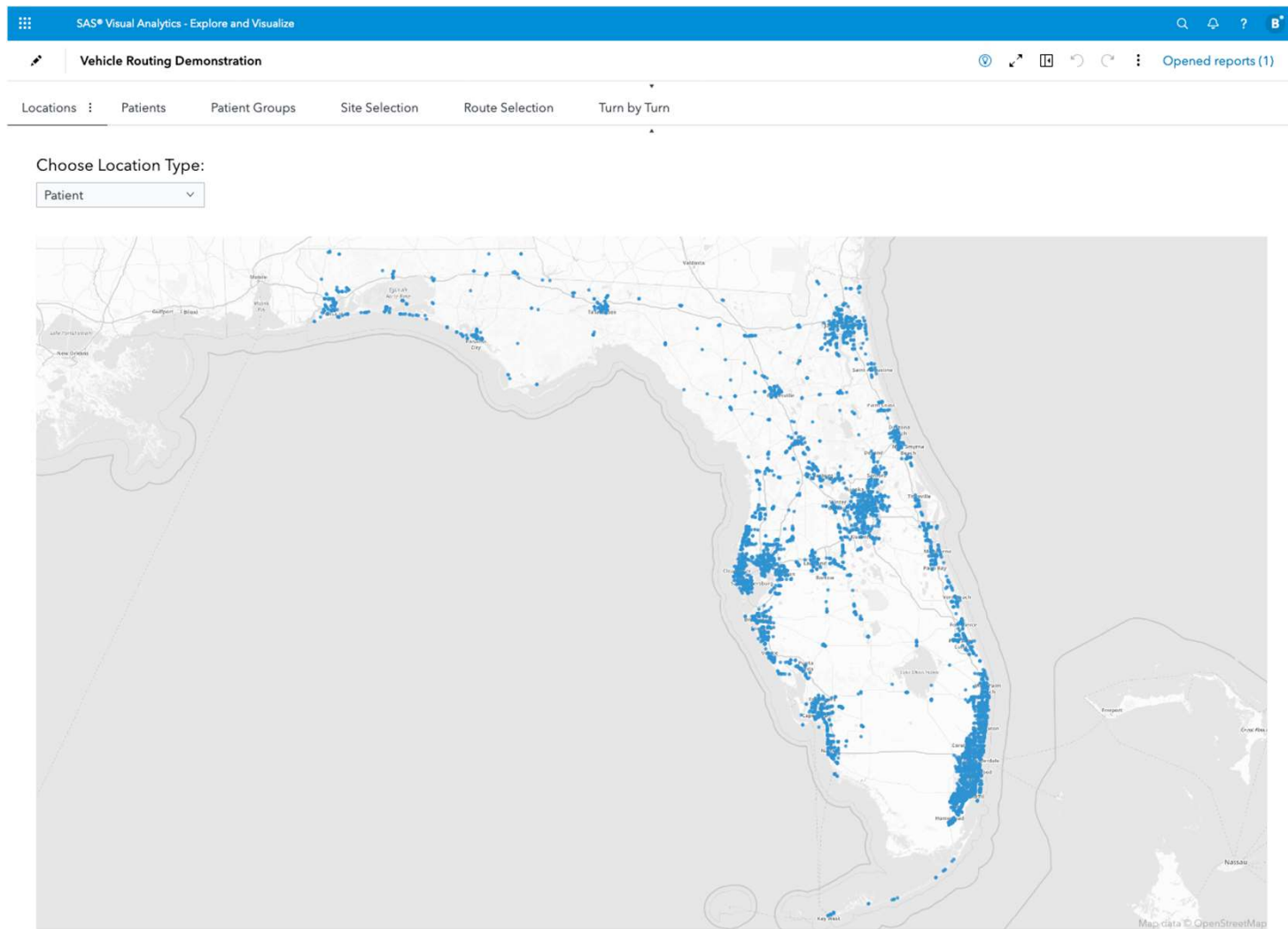
Site ID	Site Type	SAS Site Score	# Pati
935	New Parking Lot	1.67	
1069	New Parking Lot	1.24	
940	New Parking Lot	1.03	
968	Existing Parking Lot	0.69	
1079	New Parking Lot	0.69	
957	Existing Parking Lot	0.49	
993	New Parking Lot	0.20	
1020	New Parking Lot	0.01	
1005	Existing Parking Lot	0.00	
1064	New Parking Lot	0.00	
874	Existing Parking Lot	0.00	
1009	Existing Parking Lot	0.00	
789	New Parking Lot	-0.21	
1053	Existing Parking Lot	-0.26	
1066	New Parking Lot	-0.29	
999	Existing Parking Lot	-0.31	
954	New Parking Lot	-0.38	
732	Existing Parking Lot	-0.41	
1003	New Parking Lot	-0.51	
1087	New Parking Lot	-0.55	
1036	New Parking Lot	-0.68	
748	Existing Parking Lot	-0.81	
955	New Parking Lot	-1.39	
972	Existing Parking Lot	-1.73	

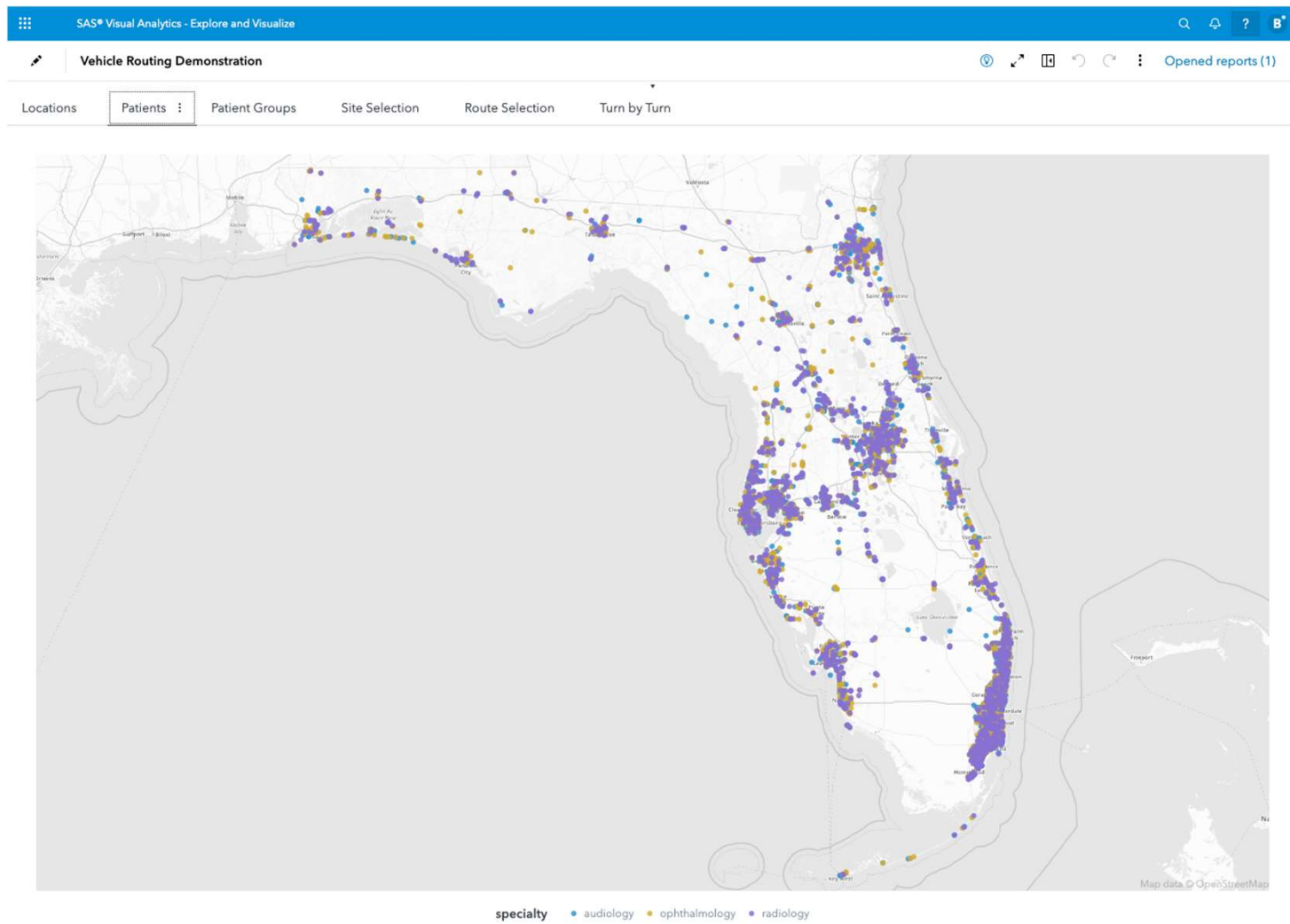


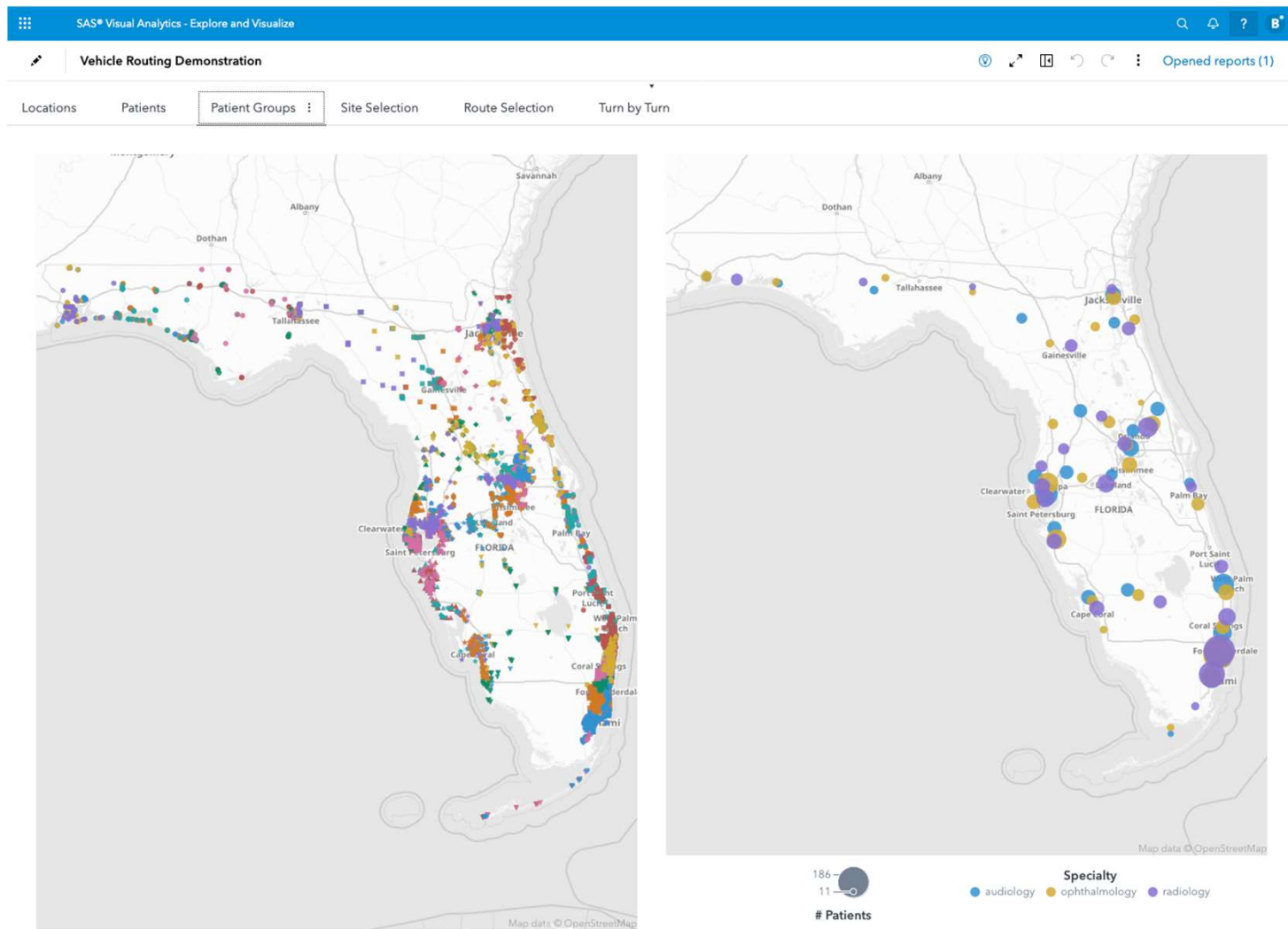
# DEMO!

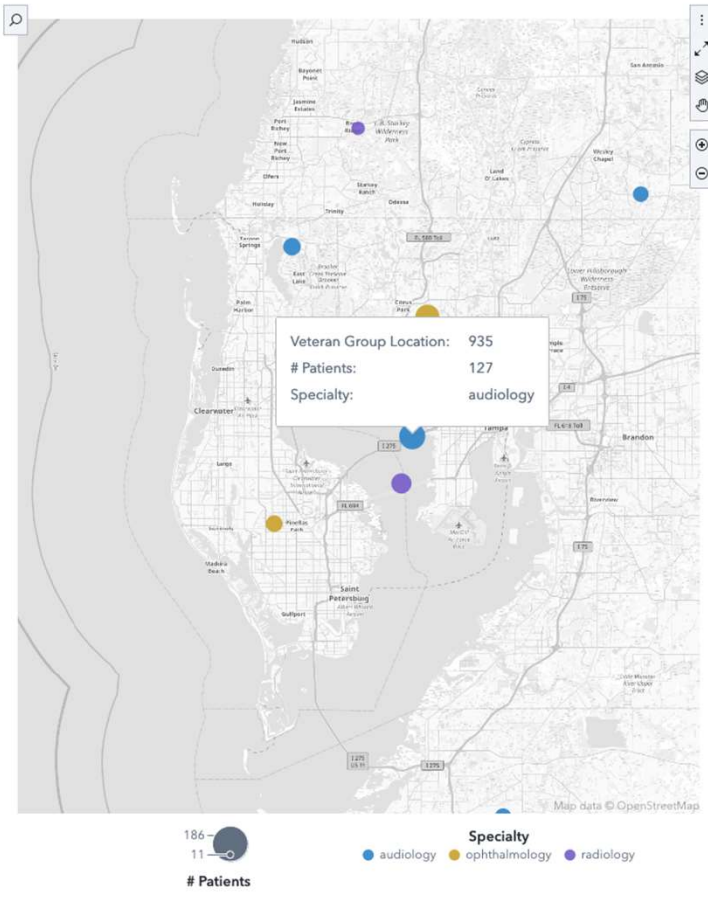
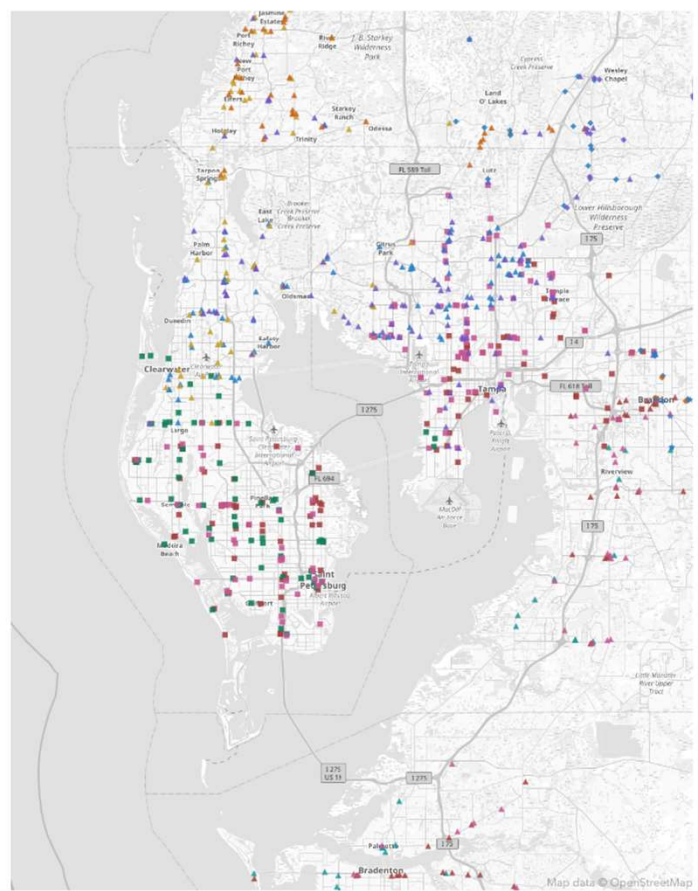
# Appendix

## Screenshots of the Demo





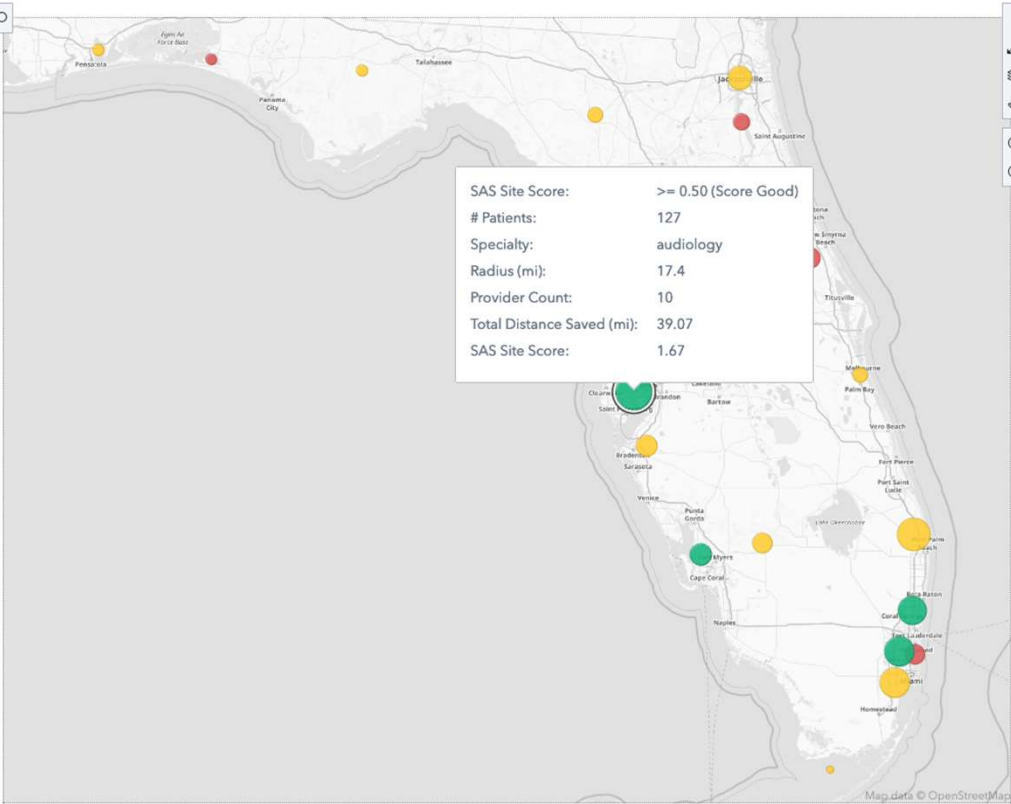






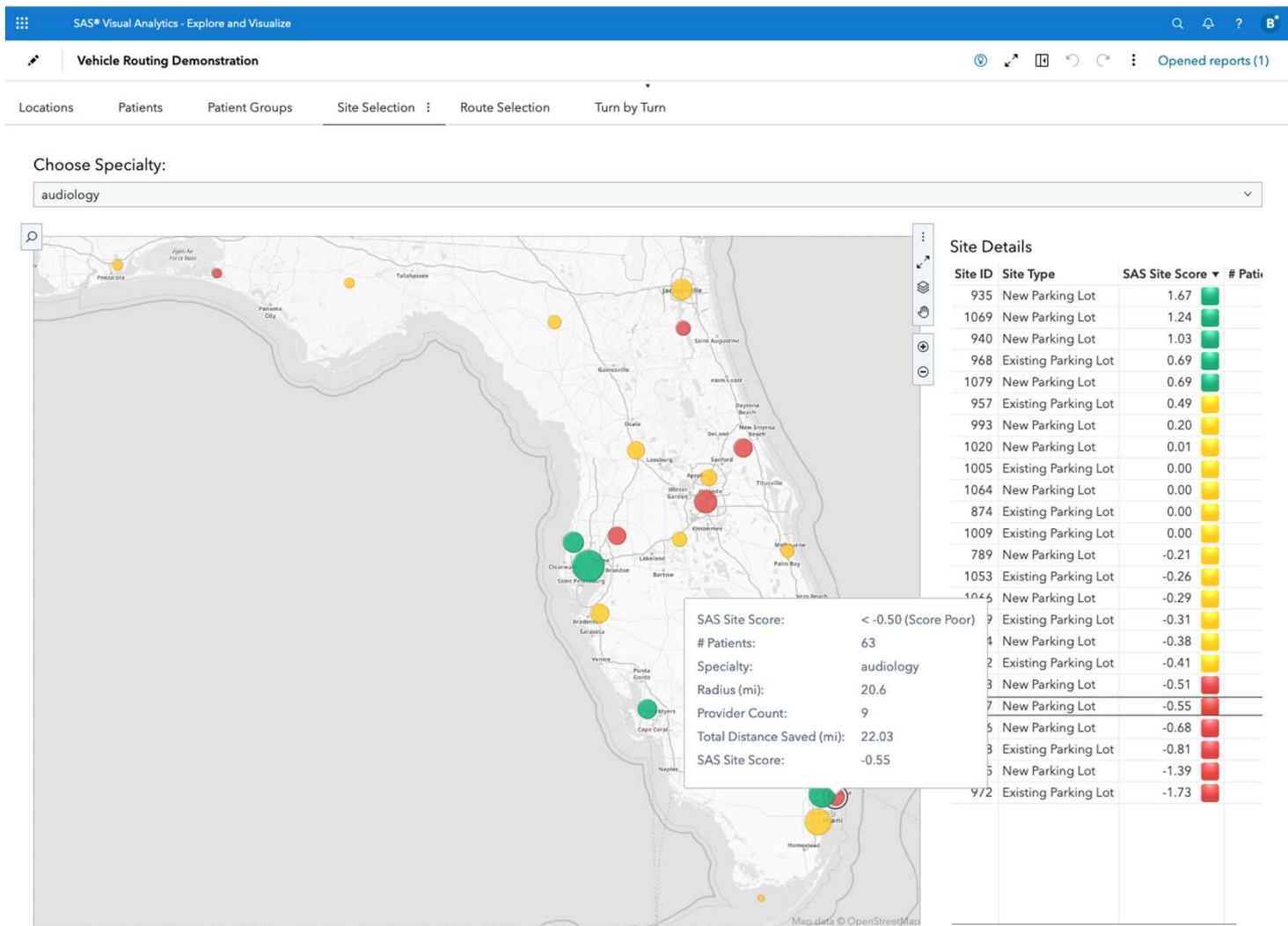
Choose Specialty:

audiology



Site Details

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Vehicle Routing Demonstration

Opened reports (1)

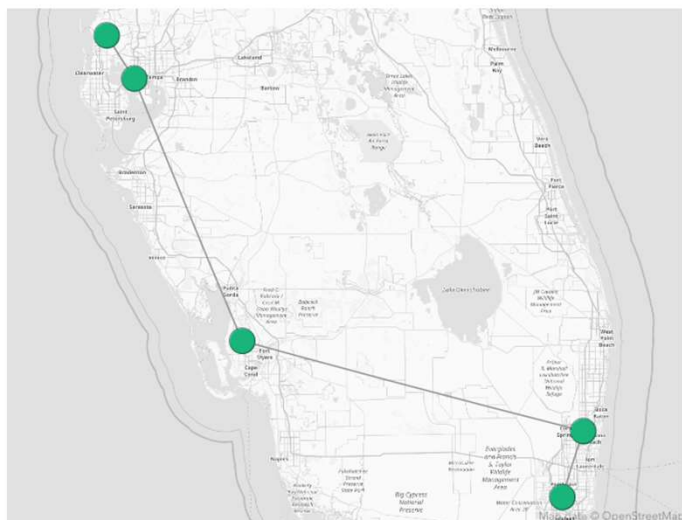
Locations Patients Patient Groups Site Selection Route Selection Turn by Turn

Select Specialty

audiology

Choose Scenario (left):

a) Short Route - Maximize Efficiency



Route Metrics - Totals

Route Metrics - Per Stop / Per Mile

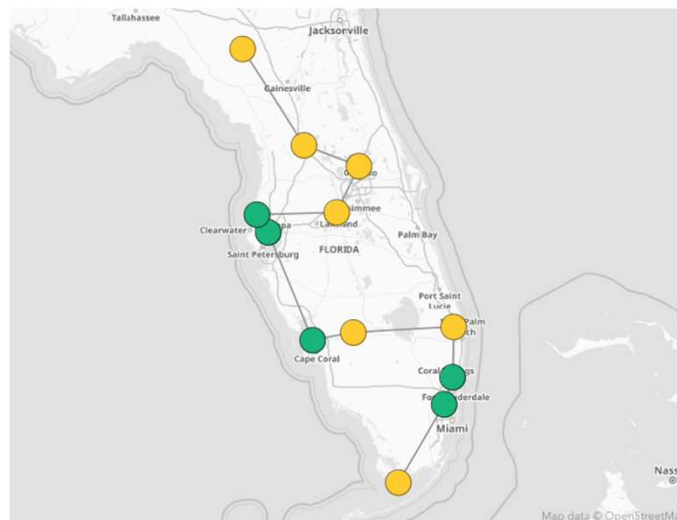
# Patients  
**472**

# Stops  
**5**

Total Distance (mi)  
**247**

Choose Scenario (right):

c) Long Route - Maximize Coverage



Route Metrics - Totals

Route Metrics - Per Stop / Per Mile

# Patients  
**876**

# Stops  
**12**

Total Distance (mi)  
**596**

Vehicle Routing Demonstration

Opened reports (1)

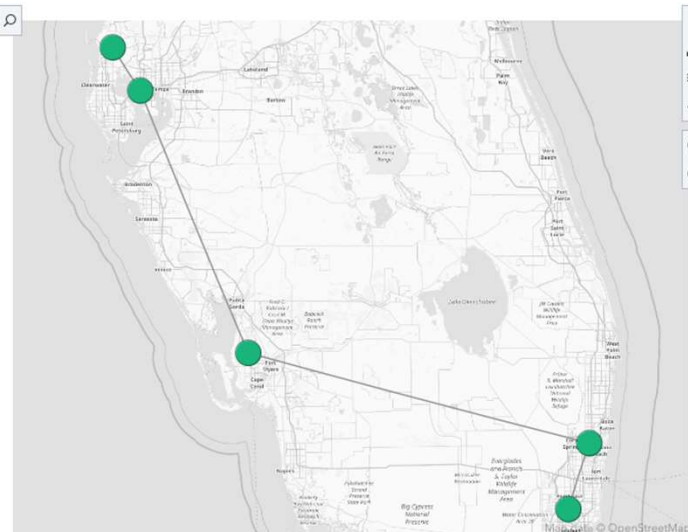
Locations Patients Patient Groups Site Selection Route Selection Turn by Turn

Select Specialty

audiology

Choose Scenario (left):

a) Short Route - Maximize Efficiency



Route Metrics - Totals Route Metrics - Per Stop / Per Mile

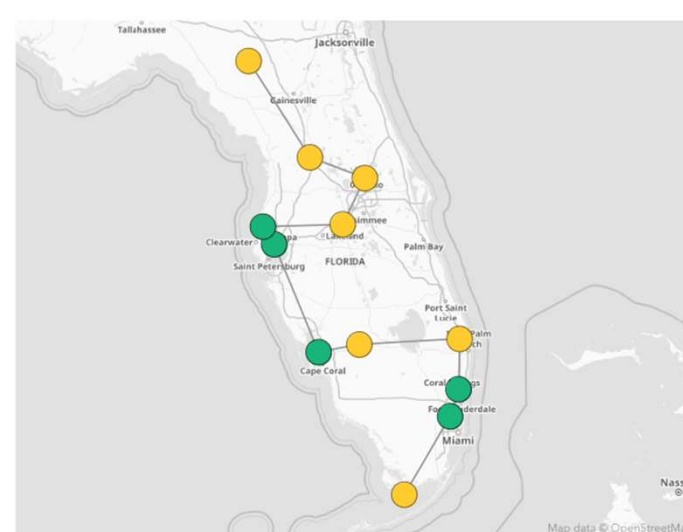
# Patients  
472

Patients Served Per Stop  
94.40

Patients Served Per Mile Traveled  
1.91

Choose Scenario (right):

c) Long Route - Maximize Coverage



Route Metrics - Totals Route Metrics - Per Stop / Per Mile

# Patients  
876

Patients Served Per Stop  
73.00

Patients Served Per Mile Traveled  
1.47

Vehicle Routing Demonstration

Opened reports (1)

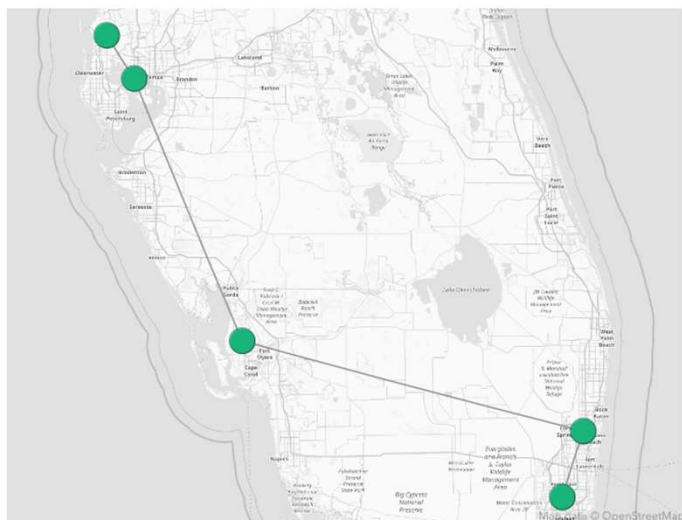
Locations Patients Patient Groups Site Selection Route Selection Turn by Turn

Select Specialty

audiology

Choose Scenario (left):

a) Short Route - Maximize Efficiency



Route Metrics - Totals

Route Metrics - Per Stop / Per Mile

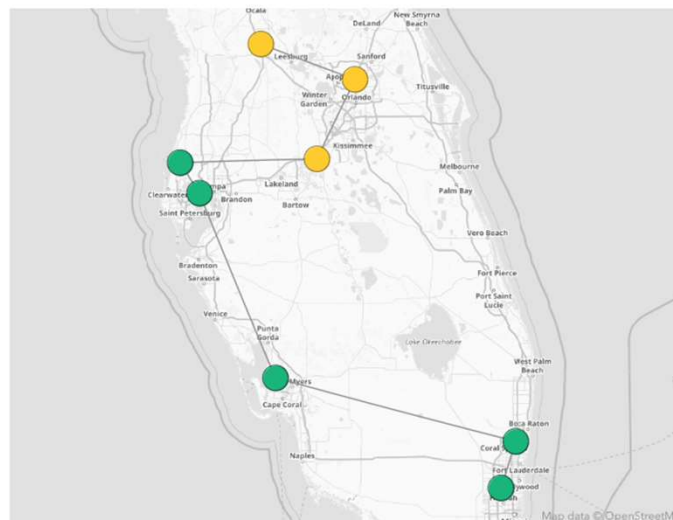
# Patients  
**472**

# Stops  
**5**

Total Distance (mi)  
**247**

Choose Scenario (right):

b) Medium Route



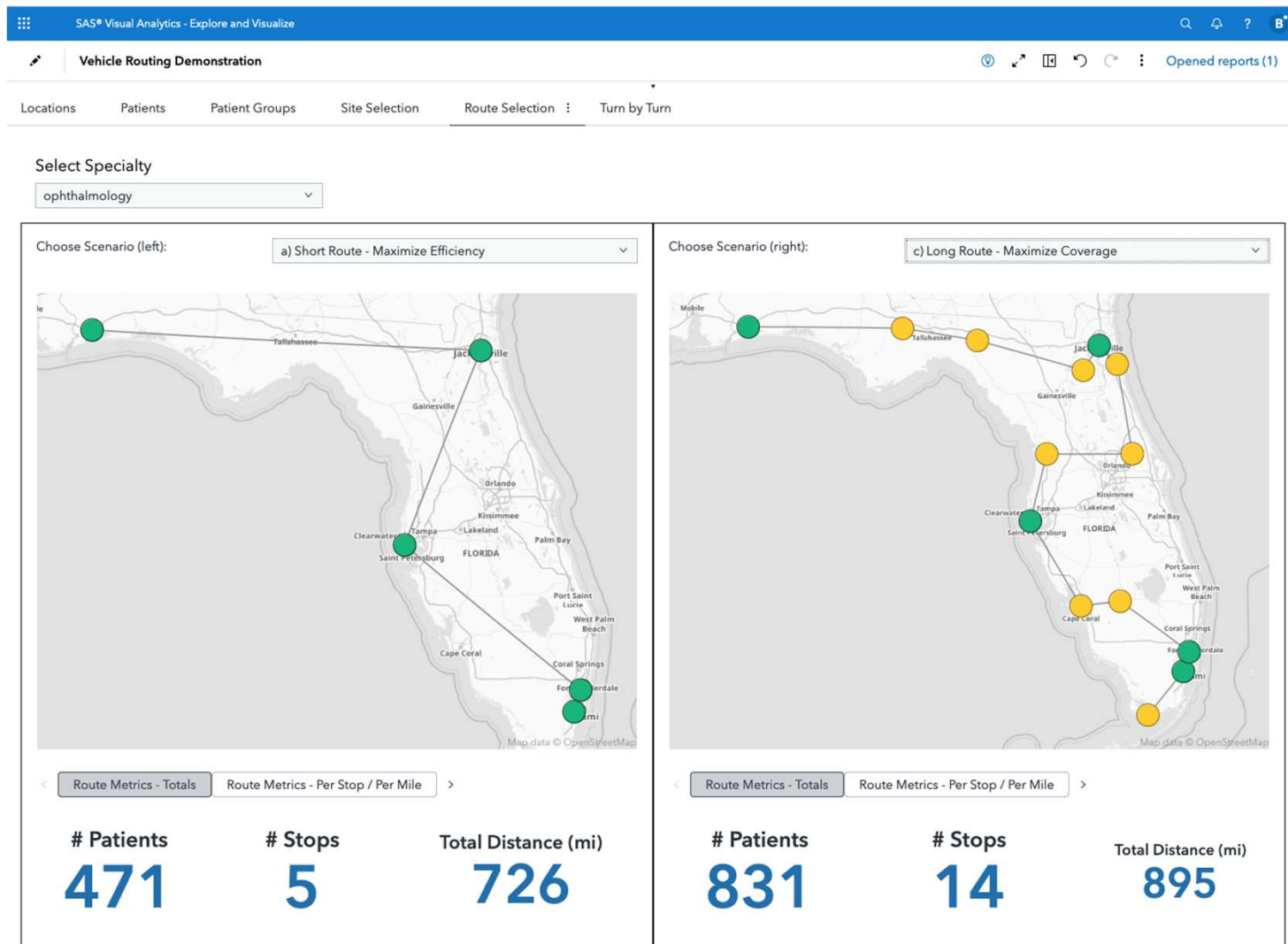
Route Metrics - Totals

Route Metrics - Per Stop / Per Mile

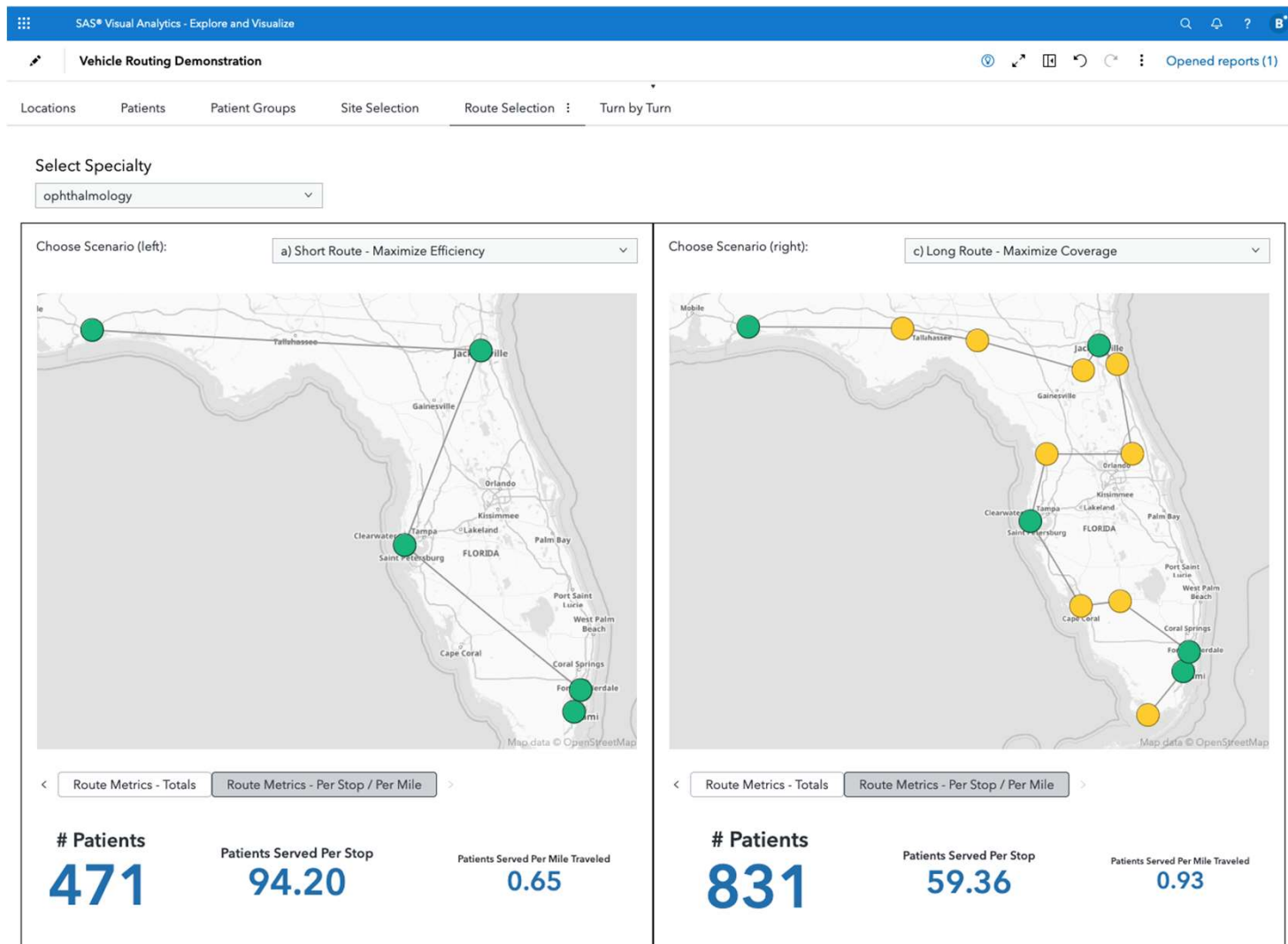
# Patients  
**642**

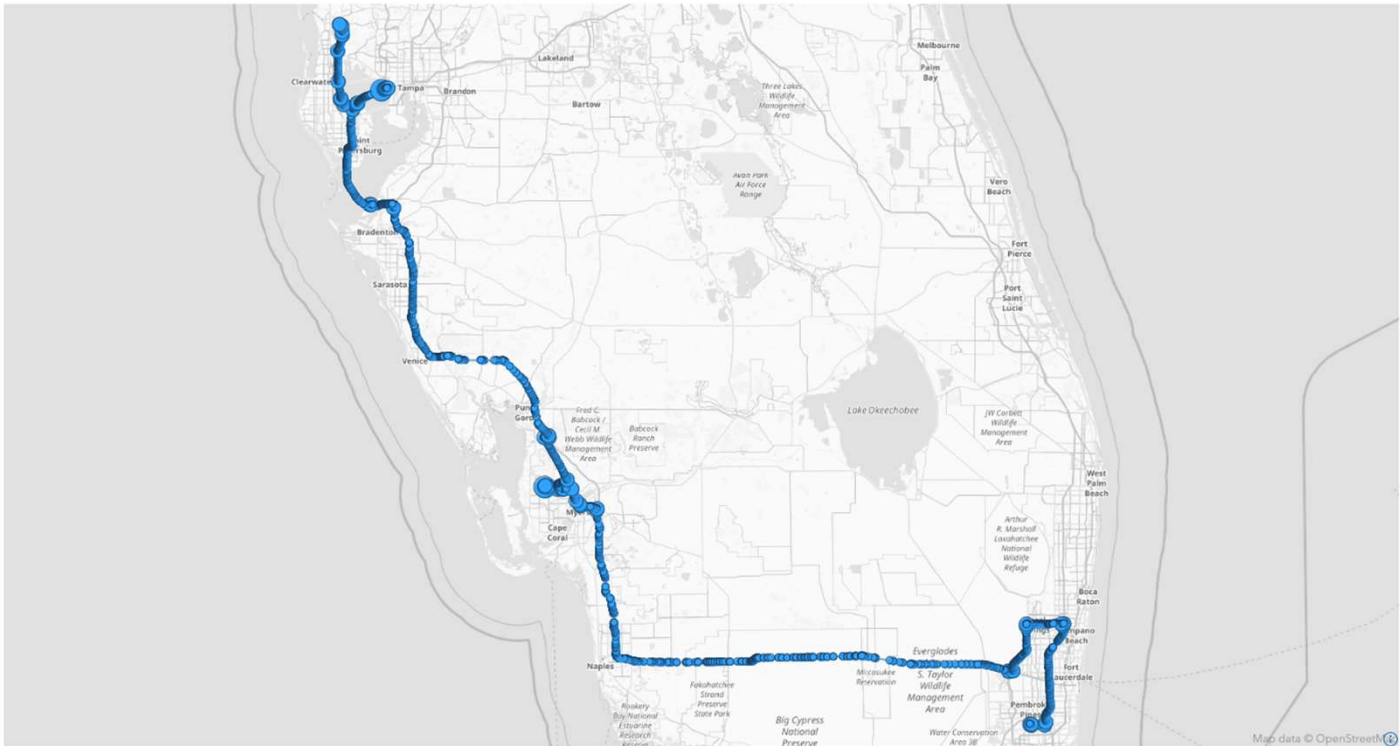
# Stops  
**8**

Total Distance (mi)  
**397**









step ▲	modifier	name	type	distance	duration
0	right	56th Place	depart	1122.5	161.5
13	slight left	Monroe Circle	new name	7200.7	1064.7
14	right	Monroe Circle	turn	1526	224